



**NOAA Teacher at Sea
Thomas Nassif
Onboard NOAA Ship NANCY FOSTER
July 15 – 30, 2005**

Log 1

DAILY LOG – JULY 15

Teacher At Sea: Thomas Nassif
Ship: NANCY FOSTER
Mission: Invasive Lionfish Cruise

Day 1: Friday July 15, 2005
Latitude: 34_43'N
Longitude: 76_42'W
Visibility: 10 nautical miles (nm)
Wind direction: 200_
Wind speed: 11 kts
Sea wave height: less than 1 foot
Swell wave height: none
Sea water temperature: 87 F,
30.5_C
Sea level pressure: 1017.9 mb
Relative Humidity: 86%
Cloud cover: 2/8, Cumulus, Stratocumulus, Cirrostratus



My first morning aboard the NOAA research vessel NANCY FOSTER began with a loud pounding sound on my door at 2am. I immediately awoke to a voice from the Lieutenant, "Thomas Nassif, you must move your care immediately!" Evidently I was parked directly in front of a giant crane on the portside of the ship. Later in the day I marveled at the enormous size of the NANCY FOSTER, which stands at 187 feet long and 894 tons. Eight SCUBA divers diligently worked on deck to ensure that their diving equipment was in good working condition when the deep-sea dives get underway tomorrow. We were scheduled to depart Morehead City today, but due to a problem with the ship's computer system we are not leaving for the open sea until tomorrow morning at 1000 hours. Two specialists arrived early this afternoon to work on the computer system that runs the entire ship, including propulsion, navigation, lighting, and air conditioning. Imagine how complicated the computer system must be, having been built in Canada, programmed with Russian software, and used on an American ship! Evidently they are the only computer specialists in the entire US who know how to fix the NANCY FOSTER's intricate computer system.

We took advantage of the delay in our departure to walk along the Morehead City Port to check out The Bounty, a replica of the legendary 18th century British Naval ship that sank off the shores of Tahiti. I imagined what it must have been like to be aboard The Bounty

in the 1700's. Unlike the NANCY FOSTER's heavy reliance on computers to run the entire ship, the Bounty only needed a ship's wheel for steering and enormous sails to propel the ship forward. This replica of the Bounty was built in 1961 for the Marlin



Brando movie "Mutiny on the Bounty" and more recently appeared in "Pirates of the Caribbean." The original Bounty was an 18th century British Naval ship under the direction of Captain Bligh. A member of the crew, Fletcher Henderson, led a mutiny against the ship's captain to protest his extremely strict and regimented control over the crew. While on route to Tahiti, a mutiny erupted between the Captain Bligh and the crew over whether to proceed around the tip of South America

(Cape Horn), one of the most treacherous routes for ships to circumnavigate. And to think that one of the major goals of the Tahiti expedition was to collect Bread Fruit for possible use as a food staple for British colonies in the Caribbean. One of the scientists aboard our cruise commented: "I tasted bread fruit once in Micronesia. I must admit it was one of the foulest tasting foods I'd ever had. Bread fruit is hard, yellow, grainy, and terribly bitter."

Question of the day:

How many people are aboard the ship for the Lion Fish Cruise?

There are 16 crew members aboard the NANCY FOSTER to ensure the ship runs properly and 7 scuba divers who will conduct deep-sea research on Lion Fish. Additionally there are two reporters from the Philadelphia Enquirer who are researching the Gulf Stream. And finally one teacher (that's me) who plans to create a video documentary about the Lion Fish cruise.

PICTURE CAPTIONS

THE BOUNTY: A replica of The Bounty, an 18th Century British Naval Research Vessel. Photo taken by Thomas Nassif.

THE NANCY FOSTER: Thomas Nassif stands in front of the NOAA research vessel NANCY FOSTER. Photo taken by Thomas Nassif.



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Log 2

DAILY LOG – JULY 16

Day 2: Saturday, July 16, 2005

Latitude: 34_15'N

Longitude: 76_36'W

Visibility: 10 nautical miles
(nm)

Wind direction: 205_

Wind speed: 11 kts

Sea wave height: 2-3'

Swell wave height: 3-4'

Sea water temperature: 27_C

Sea level pressure: 1019.7 mb

Cloud cover: 2/8,

Stratocumulus, Cirrostratus



After the final computer tests, our ship finally left for sea today at 1310 hours. The NANCY FOSTER steamed ahead through choppy waters to the first dive site of the Lionfish study, "210 Rock." The dive site is located 27 nautical miles off the coast of Cape Lookout, North Carolina. At 1800 hours four SCUBA divers leaped off of the starboard side of the ship in search of Lionfish. They were equipped with two underwater video cameras and two waterproof clipboards to record their observations. The divers leaped off the boat and dove to the ocean floor (to a depth of 108 feet) to tally the number of Lionfish compared to other native species of fish within a given distance (this is called a visual transect survey).

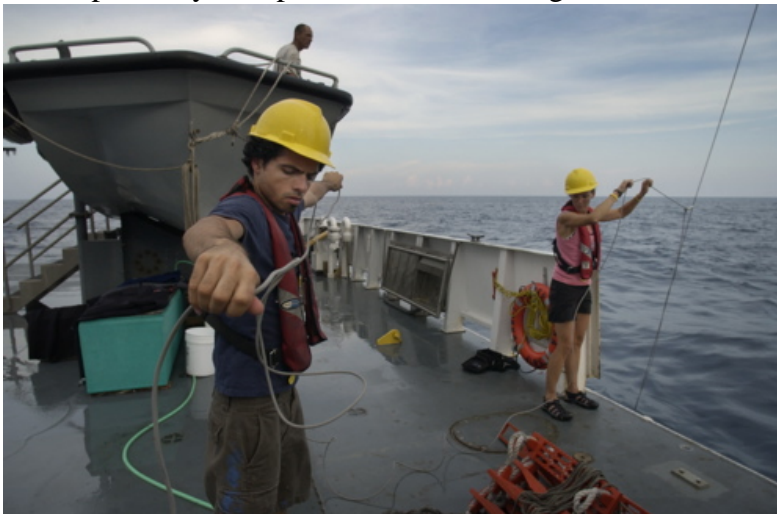
Now for a brief interlude...

What are Lionfish and why are we taking the time to study them? Lionfish are members of the scorpion fish family that are not native to the Atlantic Ocean. Organisms like the Lionfish that arrive, survive, and successfully reproduce in an ecosystem where they did not previously exist are called an invasive species. Lionfish are a very colorful fish with venomous spines originally from the Indo-Pacific coral reefs of southeastern Asia. Ever since their accidental release into the Atlantic Ocean in 1992, Lionfish have reproduced quickly and established themselves in increasing numbers along the Atlantic Coast from Florida to North Carolina. Lionfish are ambush predators that use their venomous spines to paralyze and swallow whole fish (baby shrimp, snapper, and grouper). For this reason, their presence in the Atlantic may negatively impact the local ecosystem and pose a vital threat to the commercial fisheries industry.

Back to the divers...

Upon their return to the ship from 210 Rock, the divers discovered 10 Lionfish, all of them juveniles, approximately 20 cm. in length. Lionfish have been reported in the vicinity before, but not until recently. This suggests a possible Lionfish migration into the area from the warmer waters of the Gulf Stream several miles away in the Atlantic (Lionfish can only survive in warmer, more tropical water temperatures). Now for some good news: The divers saw an impressive variety of native fish including Adult Gag, Scamp, Red Grouper, Blue Angel Fish, Soap fish, Spotfin Hogfish, Spanish Hogfish, White Grunt, Bank Sea Bass, Black Sea Bass, Almaco Jack, and Spade Fish. All of this suggests that the ecosystem near 210 Rock is biologically diverse, vibrant, and healthy. Hopefully it will remain that way, despite the looming threat of the Lionfish in the horizon...

Personal Log: I was relieved that we were able to get at least one dive off today, despite our ship's delayed departure. Most amazing was the video footage that the divers brought



back onboard the ship – they captured several Lionfish on video, hidden beneath rocks and carefully camouflaged in their background environment. Watching the video makes me realize that the ocean floor is a dramatically different landscape than what we are accustomed to on land!

Question of the Day:

Should we worry about Lionfish closer to shore along the beaches of the Atlantic Coast? Is their sting venomous enough to kill a person?

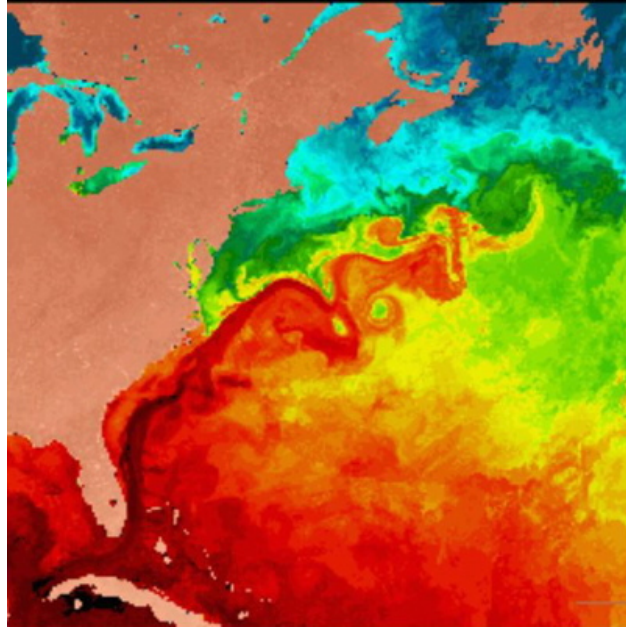
Luckily for us, a venomous spine from a Lionfish is not enough to kill a person, but they can cause a painful sting. You will also appreciate the fact that Lionfish will probably never invade beaches along the Atlantic coastline. This is because temperature limits their distribution in the Atlantic. The Gulf Stream is a warm current of the Atlantic Ocean that originates in the Gulf of Mexico and runs northeastward along North America. Because the Gulf Stream remains several miles offshore from the Atlantic coastline, these waters can remain somewhat warm during the winter, despite frigid inshore water temperatures. This is why Lionfish can survive in the Gulf Stream (where it is warmer in the wintertime) but not closer to the coast (where winter water temperatures are far colder). Additionally, Lionfish cannot survive north of Cape Hatteras, North Carolina due

to the colder water temperatures along the northeastern Atlantic coastline. For this reason, scientists consider Cape Hatteras a “Zoo-geographical boundary” beyond which Lionfish cannot stay alive.

PICTURE CAPTIONS:

LIONFISH: Underwater photograph of a lion fish taken by Doug Kesling, deep-sea diver on the NANCY FOSTER.

ON DECK: Thomas Nassif helping on deck to deploy a drop camera that sends real-time video footage of the deep sea to the ship’s television monitors.



PICTURE CAPTION (Gulf Stream): This map clearly shows the Gulf Stream in the Southeastern Atlantic (look for a dark red streak off the coast of Florida). Darker reds are the warmest ocean temperatures, blues are the coldest. Image courtesy of Paula Whitfield.



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Log 3

DAILY LOG – JULY 17

Day 3: Sunday, July 17, 2005

Latitude: 33_59'N

Longitude: 76_40'W

Visibility: 10 nautical miles (nm)

Wind direction: 200_

Wind speed: 11 kts

Sea wave height: 2-3'

Swell wave height: 3-5'

Sea water temperature: 28_C

Sea level pressure: 1020.5 mb

Cloud cover: 6/8, Cumulus,

Cirrostratus, Altocumulus



Early this morning at 0545 hours the NANCY FOSTER arrived at her next two dive locations (SEPAPNEW1 and SEPAPNEW2), 34 nautical miles due south of Beaufort Inlet. We are traveling along the Atlantic Continental Shelf, which runs along the Western boundary of the Gulf Stream. I asked the Chief Scientist, Paula Whitfield: “Why do all of our dive sites fall along the border rather than in the heart of the Gulf Stream? Since the water is much warmer in the Gulf Stream wouldn’t we be far more likely to see Lionfish since they are a tropical fish?” Paula informed me that further east of us the ocean depth drops to about 300 feet, beyond the maximum depth (150 feet) our SCUBA divers could reach. Furthermore the Gulf Stream currents would pose many risks to the divers – even a 1-2 knot current is enough to rip off a diver’s mask. Paula carefully chooses the dive locations using a bathymetric map of the ocean floor (similar to a topographic map for land).

Several things must happen before the SCUBA divers actually jump off the boat. First, drop buoys are deployed into the water to mark the exact location of each dive site. A drop buoy basically consists of bright orange buoy that floats on the ocean surface to let the ship know where the divers are located. To hold the orange buoy in the same location, it is attached to an anchor and a 10-lb weight by a 150-ft cord that sinks to the ocean floor. The drop buoy also helps the divers orient themselves during their descent to the ocean floor. By following the bright yellow cord during their descent, the divers can reach the exact dive location on the ocean floor.

The next step is to deploy two small boats, the RHIB (Rigid Hull Inflatable Boat) and the NF4. The RHIB holds the oxygen manifold, which supplies pure oxygen to the SCUBA divers after they finish their dive and begin their gradual ascent to the ocean surface

(divers must decompress or wait at 20 feet below the ocean surface after their dive to ensure they acclimate to the change in pressure). The NF4 is a larger more sturdy boat used to recover the divers and bring them back safely to the ship.



Finally the divers are ready to jump off the ship, and this is no easy task. Imagine having to jump off the side of the ship with 200 pounds of SCUBA gear strapped to your back. Most of this weight is due to two enormous air tanks that deep-sea divers must carry to ensure they have enough air to breath during their 130-foot dive!

Personal log: Today was an extremely busy day! Somehow the dive teams were able to squeeze in 4 different dive locations on the ocean floor in the same day - 2 dives in the morning and 2 dives in the afternoon. This time the divers were equipped with nets to capture live Lionfish and spear guns to collect dead Lionfish. The divers returned to the ship with 19 Lionfish! Amazingly, they collected 17 live Lionfish and stored them in the holding tank aboard the ship. The scientists performed a dissection on the remaining two Lionfish (that arrived to the ship already dead). Watching the dissection made me realize that the internal anatomy of the Lionfish is no different from any other fish (except for their venomous spines of course!)

Question of the day:
Are Lionfish edible?

Jose, I must admit that I answered your question incorrectly at the Carnegie Institute summer course...Yes (to my surprise) Lionfish can be eaten, and their venomous spines have no harmful affects when ingested. In fact, some members of the scientific team have tasted Lionfish, and described the white meat of the fish as chewy, not tender, and a bit fishy tasting. Hopefully I will have the opportunity develop a recipe for Lionfish curry before the cruise is over.

PICTURE CAPTIONS

DIVER: Deep-sea diver Christine Addison takes a leaping plunge into the ocean off the deck of the NANCY FOSTER. Photo taken by Thomas Nassif.

NF4 – RHIB: The NF4 (shown in front) is transporting divers back to the ship after a successful dive. The RHIB (shown behind) carries an oxygen manifold that delivered pure oxygen to the divers during their ascent from the ocean floor. Photo taken by Thomas Nassif.



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DAILY LOG – JULY 18

Day 4: Monday, July 18, 2005
Latitude: 33_38'N
Longitude: 76_55'W
Visibility: 10 nautical miles (nm)
Wind direction: 240_
Wind speed: 13 kts
Sea wave height: 1-2'
Swell wave height: 2-3'
Sea water temperature: 28.9_C
Sea level pressure: 1018 mb
Cloud cover: 6/8, Cumulus,
Alto cumulus



Science & Technology Log

Today we awoke to a cloudy overcast day, providing the divers some relief from the sweltering heat we've had the past few days. The jet-black wet suits that keep the divers thermally insulated on the ocean floor can become extremely hot under a scorching sun!



Every day for the remainder of the cruise we will try to complete 2 dives in the morning and 2 dives in the afternoon, each at a different location along the seafloor. (The divers are divided into two rotating teams, so that each person will only have to dive once in the morning and once in the afternoon).

This morning the divers visited Big Fish 1 and Big Fish 2, appropriately named after an 18-inch lionfish that was caught by a local fisherman. At Big Fish 2, the dive team descended to a depth of 143 feet, and they were stunned at the sight of 5 enormous lobsters; several were hiding beneath rocks while two other lobsters chased after one another across the sand. They also spotted several large grouper (approx. 30 lbs each). They conducted a 100-meter visual transect by steadily unreeling meter tape in a straight line. Along those 100 meters of line, they

counted 17 lionfish (mostly juveniles), a big surprise considering the sandy bottom and featureless bathymetry (elevation) of the region. Lionfish typically thrive near rocky outcrops and coral reef structures that provide niches for other organisms that would serve as potential food sources (including baby shrimp, grouper, and snapper). Findings like the one at Big Fish 2 suggest that lionfish can flourish anywhere, from flat sandy bottoms to hard rocky outcrops, we suspect that as long as the water temperature remains warm enough to support a tropical habitat.

On the fourth and final dive of the day, the divers speared 3 lionfish and brought them back onto the ship for analysis. The scientists dissected the lionfish within 30 minutes of being brought onto the ship to ensure high quality stomach and reproductive system samples. First they recorded the weight, total length, and standard length (backbone only) of the lionfish. Next they removed both gonads and recorded the combined weight to determine the reproductive status of the lionfish. Finally they removed the stomach to determine the diet of the lionfish. We found two small fish that the lionfish had ingested. The lionfish remains were then frozen for future morphological (external) analysis. Scientists at the NOAA Beaufort Laboratory will conduct spine & ray counts on the fins and observe the facial features to see if there is any correlation with the development of the bearded spine, a feature that lionfish are thought to acquire as they age.

Question of the day:

Do lionfish have any predators?

Great question! Lionfish do not have any known predators, but scientists aboard the NANCY FOSTER are hoping to someday answer this question. In Florida there was a reported sighting of a goliath grouper eating a lionfish. Other than that we do not know for sure. Of course it would be a good thing to find out. If it turns out that lionfish do not have any predators, then that would be bad news for the local ecosystem. Lionfish would be able to reproduce without limit and continue eating prey until resources are heavily depleted, thereby starving other fish that are important to the fisheries industry such as grouper.

PICTURE CAPTIONS:

TRANSECT + CLIPBOARD: Diver Christine Addison conducts a visual transect survey with a clipboard and meter tape along the ocean floor. Photo taken by Doug Kesling.

LIONFISH DISSECTION: Teacher At Sea Thomas Nassif watches Roldan Munoz perform a lionfish dissection, removing the stomach and gonads for further analysis.



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Day 5

DAILY LOG – JULY 19

Teacher at sea: Thomas Nassif
Ship: NANCY FOSTER
Invasive Lionfish Cruise

Day 5: Tuesday, July 19, 2005
Latitude: 33_38'N
Longitude: 76_56'W
Visibility: 10 nautical miles (nm)
Wind direction: 230_
Wind speed: 15 kts
Sea wave height: 1-2'
Swell wave height: 2-3'
Sea water temperature: 28.9_C (84_F)
Sea level pressure: 1019.9 mb
Cloud cover: 5/8, Cumulus, Alto cirrus



Science & Technology Log

Today was by far the most beautiful sunrise we've had since our departure from land last week. A fiery ball of radiant yellow captured the sky, as its luminous rays penetrated the hues of deep blue and wispy whites in the surrounding sky. This morning the divers visited Kinny 1 and 2 (also known as K1 and K2). But this was no ordinary dive... K2 happened to be the most challenging and strenuous dive yet. The ocean currents were moving faster than we expected. The ship pulled up-current from the dive site (marked by an orange buoy), to put the divers in position. All they would have to do is jump off the ship and drift down-current to find the buoy. But when the divers jumped off the ship they were swept away by the strong ocean currents well past the buoy. The NF4 picked up the divers, who had to take off all 200lbs of their SCUBA gear, and wait to be taken to the correct diving site. The divers eventually finished their mission at K2, but were very exhausted when they returned to the NANCY FOSTER.

Today I finally got my chance to step off the NANCY FOSTER for the afternoon. I boarded the NF4 (diver recovery boat) and we steamed off into the open sea. Soon

thereafter we watched from a distance, as the divers leap off the NANCY FOSTER. Our job was to keep an eye on the divers to ensure their safety during the 130-foot descent to the ocean floor. The NF4, along with the NANCY FOSTER and RHIB, all bear the “divers flag” when we deploy SCUBA divers into the ocean. This red flag with a diagonal white stripe warns other ships in the immediate area that there are divers in the water.

I also went snorkeling in the ocean to watch the SCUBA divers decompress underwater. After the divers finished their dive to the ocean floor, they stopped at 20 feet from the



ocean surface to breathe pure oxygen from a long tube supplied from the surface by the RHIB (the air we breathe everyday is only 21% oxygen). If the divers chose instead to shoot straight up to the ocean surface, they risk getting the “bends,” a painful experience that occurs when nitrogen bubbles form in the blood.

The divers safely returned to the ship with 6 lionfish

in their nets – the aquarium aboard the NANCY FOSTER now has a total of 25 live lionfish! The scientists plan to transport them to a more permanent home at the NOAA Beaufort Laboratory when we arrive at port next week. To simulate the natural conditions of the ocean, scientists will place the lionfish in a “flow through aquarium” that transports ocean water through a pipe into and out of the aquarium. By having several aquaria full of lionfish in the lab, scientists hope to learn more about their diet and how often they reproduce.

Question of the day:

Do lionfish reproduce in the same way as fish? How often do they reproduce?

Yes - Lionfish reproduce like most fish, through External Fertilization. Eggs are released from the female into the water and then fertilized by sperm from a male fish. The thing that makes lionfish so different from most fish is this: Female lionfish release a floating mass of eggs that stick together (most fish release eggs that disperse and spread out from each other in the water). Scientists think that lionfish are more successful at reproducing because the floating masses of eggs are more likely to be fertilized. We do not know how often lionfish reproduce – this is one of the biggest questions scientists want to find out! The reproductive periods of fish overall can be very different. Some species of fish, like Salmon, reproduce only once in their entire lifetime. Tropical organisms like the

Parrotfish, on the other hand, reproduce every day! It will be very helpful for us to know how often female lionfish reproduce so that we may better understand their impact on the local ecosystem.

PICTURE CAPTIONS

SUNRISE: “A fiery ball of radiant yellow...penetrated the hues of deep blue and wispy whites.” Photo taken by Thomas Nassif.

ABOARD THE NF4: Thomas Nassif aboard the NF4 dive boat. The NANCY FOSTER is pictured in the background. Photo taken by Thomas Nassif.



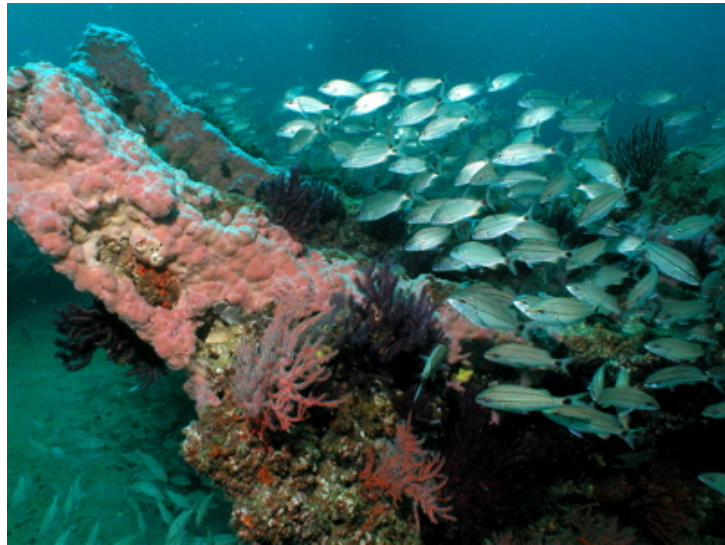
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Log 6

DAILY LOG – JULY 20

Teacher at sea: Thomas Nassif
Ship: NANCY FOSTER
Invasive Lionfish Cruise

Day 6: Wednesday, July 20,
2005
Latitude: 33_35'N
Longitude: 77_28'W
Visibility: 10 nautical miles (nm)
Wind direction: 230_
Wind speed: 12 kts
Sea wave height: 1-2'
Swell wave height: 2-3'
Sea water temperature: 28.9_C
(84_F)
Sea level pressure: 1019.2 mb
Cloud cover: 5/8, Cumulus, Stratocumulus



Science & Technology Log

My excitement and fascination with this entire diving expedition grew even more when I heard that the divers would be exploring two shipwreck sites on the ocean floor today – “18 Fathom” in the morning and “City of Houston” in the evening. Fathoms are an old unit of measurement still used by navigators today to describe the depth of the ocean (1 Fathom = 6 feet deep). The dive site “18 Fathom” is a mystery shipwreck that was discovered at a depth of 108 feet (18 Fathoms). Shipwrecks provide excellent habitats for a variety of fish, including lionfish. The broken down hull and old passageways of a shipwreck create a manmade reef upon which algae and coral grow, smaller fish hide, and larger fish feed. Rather than scrap old ships, many countries around the world clean and sink their old ships to the ocean floor to create artificial reefs for fish and other marine organisms.

After lunch, the boat steamed ahead to the next dive site, City of Houston. Far beneath the ocean surface looms an old Civil War Era shipwreck. Thousands of fish including Tomtate, Vermilion Snapper, and Silverside enveloped the divers, making the surrounding waters shimmer with silvery red. At times the number of fish were so great that the divers had trouble seeing even a few feet in front of them! Over one

hundred years after the City of Houston wrecked and fell to the seafloor, you can now see coral and algae taking over the entire manmade structure. Even so, it is still possible to make out obvious structures of the ship, including the engine and the hull.

Personal Log

Today I went snorkeling off the NF4 once again and had a fantastic time swimming in the 84°F water under a beaming sun – It's unbelievable that the Atlantic Ocean can be so warm during the summer months! Also, I've watching the divers in action as they



descend to the ocean floor, collect live lionfish, and take stupendous photos of the deep ocean all inspire me to someday become a professional SCUBA diver myself.

Question of the day:

What type of air do SCUBA divers breathe?

This depends on how deep you plan to dive. Regular air (the kind we breathe on land) is mostly nitrogen and

only 21% oxygen. The tanks that the deep-sea divers carry on their back are filled with regular air, and they can dive up to 150 feet by breathing this air through a mouthpiece (or regulator). Other divers that only need to dive up to 113 feet (like our safety divers) use Nitrox, which has more oxygen (36%) than regular air. Finally, at depths up to 20 feet deep, SCUBA divers can breath pure oxygen (100%). The deep-sea divers on our cruise switch to pure oxygen 20 feet before they reach the ocean surface to speed up their decompression.

The two dangers with SCUBA diving and the air they breathe are:

- 1 - Too much oxygen can be toxic to your body. The deeper you dive, the less oxygen you should have in the air you breathe.
- 2 - At the same time, too much nitrogen can make you feel light-headed and put you to sleep underwater. Jacques Cousteau, French inventor of the SCUBA, called this "Rapture of the Deep." That is why it is so dangerous for divers to spend too long in the deep ocean.

PICTURE CAPTIONS

SHIPWRECK REEF: A underwater photograph of the City of Houston shipwreck. Over time the ribs of the ship's hull have been covered by sponges (pink fluff) and soft coral (colorful branches). Tomtate fish are pictured to the right. Photo taken by deep-sea diver Doug Kesling.

EXPLOSION OF FISH: An explosion of Tomtate (white fish) and Vermilion Snapper (red fish) envelop the water in a silvery red glow. Photo taken by Doug Kesling.